

XXXVII.—On the Phenomena of the Reproduction of the
Chitons. By WILLIAM CLARK, Esq.

To the Editors of the *Annals of Natural History*.

GENTLEMEN,

Norfolk Crescent, Bath, November 1855.

THE Chitons have long been a source of difficulty to naturalists with respect to systematic position; the most distinguished names, Cuvier, Blainville, Milne-Edwards, and Prof. Forbes, are at variance on this point, which to the present time has not received a satisfactory solution. Cuvier alone considers them true Mollusca; Blainville refers them to the Annelidan Articulata; Forbes speaks doubtingly; and Milne-Edwards admits that they are Gasteropoda, but hesitates to acknowledge them Mollusca.

I trust the following observations, though not so complete as I could wish, will throw some light on their reproductive *status* and natural position.

The present paper has originated in a suggestion of the late Prof. Forbes and Mr. Hanley, who in their 'British Mollusca,' vol. ii. p. 390, "trust that some active observer resident by the coast will occupy himself with studying the development of the Chitons, and endeavour to ascertain the form they assume in their larval condition. Whoever does so will make an important discovery, and do more towards fixing the true position of these anomalous creatures than all cabinet examinations of them have yet enabled us to effect." And I have stated in my late work on the 'British Marine Testaceous Mollusca,' p. 248, "that I propose, if practicable, to carry out this idea, though the attempt will be attended with uncertainties which need not at present be alluded to."

Chiton cinereus, Linnæus.

Chiton cinereus, Brit. Moll. vol. ii. p. 402.

Chiton marginatus, variorum.

On the 23rd July 1855, I obtained several examples of the above species fixed on small pebbles from their natural habitat; these were carefully removed into saucers of sea-water and sedulously examined every hour for many following days. In the afternoon of the day of capture my attention was suddenly attracted by observing one of the animals in the act of discharging ova—not in volleys, but by one or two at every second for at least 15 minutes, forming a batch of 1300 to 1500; there were a thousand or more that remained in the ovarium, perhaps not sufficiently matured for parturition; they were pale yel-

low, and of subglobular form, being a little compressed or oblate at what may be termed the axes; each appeared about 100th of an inch in diameter. I may here remark that the animal now mentioned was the only one that deposited ova.

The animal, previous to the exclusion of the ova, had moved from the flat position it occupied on the stone to its edge, and elevating by reflexion the posterior portion of the coriaceous skin in which the valves are imbedded, poured out for several minutes a continuous stream of flaky white matter like a fleecy cloud, which proved of a glutinous nature, and probably proceeded from the organs which M. Cuvier and authors have conjectured to be a pair of symmetrical oviducts, but which they failed to trace to an external outlet: I rather think that they are glands, and that their use is to provide the material for the capsule or membranous envelope that contains the mass of each ovum, and also to entangle by its tenacity the congeries of ova which followed its emission to prevent them being washed away by the water, as when I attempted to remove one or two, I found they were slightly retained by adhesion: it is probable that the cloudy vapour when condensed into fluid serves for a nidus until the young are prepared to emerge from their cells. I did not succeed in ascertaining if the viscosity issued from an organ, or pair of organs, or glands distinct from the oviduct: I can only say that the ova as well as the thin smoke-coloured matter were excluded from under the centre of the coriaceous integument of the posterior terminal valve, in a similar manner as I have described them to be discharged from the posterior extremity of *Dentalium*.

I carefully inspected the ova throughout the 24th July; they remained inert at the bottom of the saucer; but on the morning of the 25th I was greatly surprised to find that all had become detached from their nidus, or position, and *swam* with *great vivacity* through every part of the water, sometimes at the surface, sometimes in the middle, and at others at the bottom; these minute objects moved with extraordinary speed, crossing a large breakfast-saucer in 30 or 40 seconds.

As soon as motion had commenced, the ova lost the subglobular figure, and assumed that of a subelongated oval approaching the Chiton shape. It has already been stated that each ovum was imbedded in a pale yellow membrane, but when the rapid swimming action took place, only half of the animal was liberated from the capsule, the anterior skin being reflexed or withdrawn on the still adhering posterior portion, forming a ridge that divided the animal into two sections. With a power of 300 linear I could see the elements of the four anterior valves, as well as the buccal depression and head: this very early

stage of development showed no metamorphosis that I could perceive.

On the 26th July the animal was evidently more detached from its cell, as the five anterior valves were distinctly marked and the fringe margin was detected; the three posterior valves were still covered by the enveloping skin, but traceable through the diaphaneity of the membrane. The animal still swam with unabated vigour. On the 29th and 30th it had altogether cast off the embryonic covering and exhibited the complete form of the Chiton. During these phases of development every point posteally and anteally appeared destitute of accessories, except the usual circumferential fringe; no antennæ, tentacula, eyes, caudal appendage, articulated feet, bristles or filaments were discoverable, nor any other exerted organ. At this period nearly all natatory motion had ceased, the animal remained apparently fixed at the bottom of the saucer, and only a slight change of place was perceptible with a good lens.

The animal in its phase of rapid movement often rolled itself into a ball, which led me to think there might be some alliance between it and the crustaceous Articulata, particularly with the *Oniscus entomon*, as I have often seen adult Chitons involve themselves in a somewhat similar globular form. Notwithstanding these traits of relationship with other tribes, it cannot admit of doubt, from M. Cuvier's dissections and our own detailed account of the animal, that the Chitons are far nearer to the Mollusca than to any other class; for though we may observe some traces of approach to certain sections of the Crustacea in the segmental disposition of the hard parts, still this condition does not obtain in the soft parts of the body, which are inarticulate or molluscan; and we may add that the testaceous pieces are not connected by articulation, but merely overlap each other. The supposed relation to other divisions, the annelidan and cirripodan Articulata, is still slighter, and does not with the former, as to external organs, extend much beyond the marginal fringe, which may have an equivocal assimilation with the feet, bristles and tufts of hair of that vermiform tribe; and with the latter there is some community by the somewhat similar division of the cone into distinct pieces.

These *quasi* alliances may perhaps induce us to admit that the Chitons may be the immediate precursors or the stage of transition from the Articulata to the Mollusca, which of course takes precedence of all the divisions of the Articulata; that is, the order of natural position in the ascending scale should be: Annelida, Crustacea, Insecta, Mollusca.

It is difficult to account for or explain the propelling power of the rapid natation of the Chitons; it may probably be due to

the vermicular action of the body and foot, which is doubtless much aided by the segmental disposition of the hard parts. It is also possible that the fringed margin may act as a paddle, as well as being subservient to a very opposite action, that of increasing the tenacity of suctional adhesion. As to the bristles that are sometimes seen at the sutures of each valve above the margin, I believe they are accidental or ornamental, and have no particular use in the animal œconomy; they only appear in one British species, the *C. fascicularis*.

The singular fact of the almost instantaneous rapid natation of the animal before it is even entirely freed from the capsule, leads to a fair presumption that the oviparous germs of all the bivalve and gasteropodous Mollusca have, as they emerge from their larval condition, the power, for a limited time, of locomotion, which is accorded them by nature apparently for the purpose of seeking out and conveying themselves to their respective peculiar habitats; and we learn by the present case that, as soon as a rapid locomotion has accomplished its objects, it ceases, and the animal adopts the phase of progression that is ordained for it.

I regret that circumstances prevented the examination being carried on beyond the 31st July, but I cannot believe that, after that time, any metamorphosis would have presented itself. During the eight days of inspection no unusual aberrations of form were visible; nothing appeared but a gradual increase of the organism until it had assumed the figure and attributes of a completed Chiton, which, in the interval I speak of, had attained the length of $\frac{1}{20}$ th to $\frac{1}{30}$ th, and breadth $\frac{1}{43}$ th of an inch.

It appears, then, that M. Cuvier's determination is correct, that the Chitons are cyclobranchiate Mollusca.

I am, Gentlemen,

Your most obedient servant,

WILLIAM CLARK.

XXXVIII. — *Note on Linaria sepium, Allman.*
By CHARLES C. BABINGTON, M.A., F.R.S. &c.*

EARLY in the summer of 1855 I succeeded in obtaining seeds of this plant from roots growing in the Cambridge Botanical Garden which had been originally sent to it by Dr. Allman from Bandon. These seeds were sown in a pot, and produced many plants which flowered in the August and September following. The produce thus obtained shows that my former

* Read to the Edinburgh Botanical Society, Nov. 8th, 1855.
Ann. & Mag. N. Hist. Ser. 2. Vol. xvi.